Stoller
Hanford Office

DOE-EM/GJ654-2004

299-E25-7 (A6026)
Log Data Report

Borehole Information:

Borehole: 299-E25-7 (A6026)			**Site:** 216-A-8 Crib		
Coordinates (WA State Plane)		**GWL (ft)[1]:** 260.3		**GWL Date:** 4/16/2004	
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
136,197.87 m	575,745.61 m	May 1956	202.035 m	290	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	+2.6	6 5/8	6 1/8	1/4	+2.6	232.6
Welded steel	0.3	8 5/8	unknown	unknown	+0.3	290
The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated. The 8-in. casing is visible at the ground surface. Grout surrounds the casing and is in the annulus.						

Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS[3], and Ledgerwood (1993). Zero reference is the top of the 6-in. casing.

Logging Equipment Information:

Logging System:	Gamma 1G		**Type:** 35% HPGe (34TP10967A)
Calibration Date:	01/2004	**Calibration Reference:**	GJO-2004-597-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5 / Repeat
Date	4/16/03	4/19/03	4/20/03	4/21/03	4/21/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	20.0	259.0	162.0	60.0	36.0
Finish Depth (ft)	3.0	161.0	59.0	19.0	19.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A[4]	N/A	N/A	N/A	N/A
Pre-Verification	AG070CAB	AG071CAB	AG072CAB	AG073CAB	AG073CAB
Start File	AG070000	AG071000	AG072000	AG073000	AG073042

Log Run	1	2	3	4	5 / Repeat
Finish File	AG070017	AG071098	AG072103	AG073041	AG073059
Post-Verification	AG070CAA	AG071CAA	AG072CAA	AG073CAA	AG073CAA
Depth Return Error (in.)	0	-1	-1	N/A	-1
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	Repeat section.

Logging Operation Notes:

Zero reference was top of the 6-in. casing. Logging was performed without the centralizer on the sonde for spectral data collected on 4/19/2004. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118. Maximum logging depth achieved was 259.0 ft, approximately 1 ft above groundwater.

Analysis Notes:

Analyst:	Sobczyk	Date:	04/26/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. All of the post-run verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 3.5 percent lower and 6.9 percent higher at the end of the day.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G1GJan04.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 6-in. casing. Based on Ledgerwood (1993), the casing configuration was assumed to be a string of 6-in. casing with a thickness of 1/4 in. to a log depth of 232.6 ft and a string of 8-in. casing with a thickness of 0.322 in. to total logging depth (259 ft). The 6-in. casing thickness was measured by the logging engineer. A casing thicknesss of 0.322 in. was assumed for the 8-in. casing. This thickness is the published value for ASTM schedule-40 steel pipe, a commonly used casing material at Hanford. Where more than one casing exists at a depth, the casing correction is additive (e.g., the correction for both 6-in. and 8-in. casing would be 0.25 + 0.322 = 0.572). Water and dead time corrections were not required.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. In addition, a comparison log plot of ^{137}Cs is provided to compare the data collected in 1995 by Westinghouse Hanford Company's Radionuclide Logging System (RLS) with SGLS data. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected in three intervals. ^{137}Cs was detected from near the ground surface to a log depth of 9 ft. The range of concentrations was from the MDL (0.2 pCi/g) to 5.7 pCi/g. ^{137}Cs was detected at log depths between 20 and 59 ft. The range of concentrations was from 0.3 pCi/g to 3.6 pCi/g; the maximum concentration was measured at 25 ft. ^{137}Cs was detected at log depths between 225 and 236 ft. The range of concentrations was from near the MDL to 3.2 pCi/g, which was measured at 228 ft. ^{137}Cs was also detected at 209, 245, and 246 ft at concentrations near the MDL.

The concentrations of the KUT and man-made radionuclides above 225 ft are under estimated due to the effects of grout. ^{40}K concentrations are relatively low in the interval between 145 and 185 ft. Natural ^{238}U concentrations are elevated by about 1 pCi/g in the interval between 246 and 250 ft.

The behavior of the ^{238}U log suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi, under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. When radon is present, ^{214}Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with ^{222}Rn. Because the additional ^{214}Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) This effect is seen on logging run 2 (259 to 161 ft). The effects of radon appear to be minimal in the other log runs. The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb.

The presence of radon is not an indication of man-made contamination: it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides (609, 1461, 1764, and 2614 keV) and ^{137}Cs.

Gross gamma logs from Additon et al. (1977) (attached) indicate that the sediments surrounding this borehole contained significant amounts of man-made gamma radiation from 1958 through at least 1976. The logs from 1958, 1959, and 1963 indicate gamma-emitting contamination at or near groundwater. The logs from 2/19/58, 6/1/59, and 5/14/63 appear to detect relatively high gamma activity in the interval from 16 ft (5 m) to 131 ft (40 m). The logs from 4/25/68 and 4/30/76 appear to detect elevated gamma activity near the surface and in the interval from 19 ft (6 m) to 43 ft (13 m). Comparison of these gross gamma logs indicates that a major contamination event occurred prior 1958. The SGLS detected ^{137}Cs in all of the contaminated intervals, which had elevated gamma in the late 1950s.

A comparison log plot of ^{137}Cs data collected in 1995 by Westinghouse Hanford Company (WHC) and in 2004 by Stoller is included. The WHC concentration data for ^{137}Cs are decayed to the date of the SGLS logging event in April 2004. There is a 1990 RLS log run to a depth of 103 ft; however, little ^{137}Cs was reported in the interval between the surface and 59 ft. This logging run is described as a "system shake down test". The reported results from the 1990 log run are considered unreliable because the tool was not calibrated until a year after the log run. There may be a depth registration discrepancy between the 1995 and 2004 log runs below 200 ft. Taking into account the differences in depth registration, the apparent ^{137}Cs concentrations show good agreement between the logging systems. Since 1995, ^{137}Cs activities have probably decreased as predicted by radioactive decay.

References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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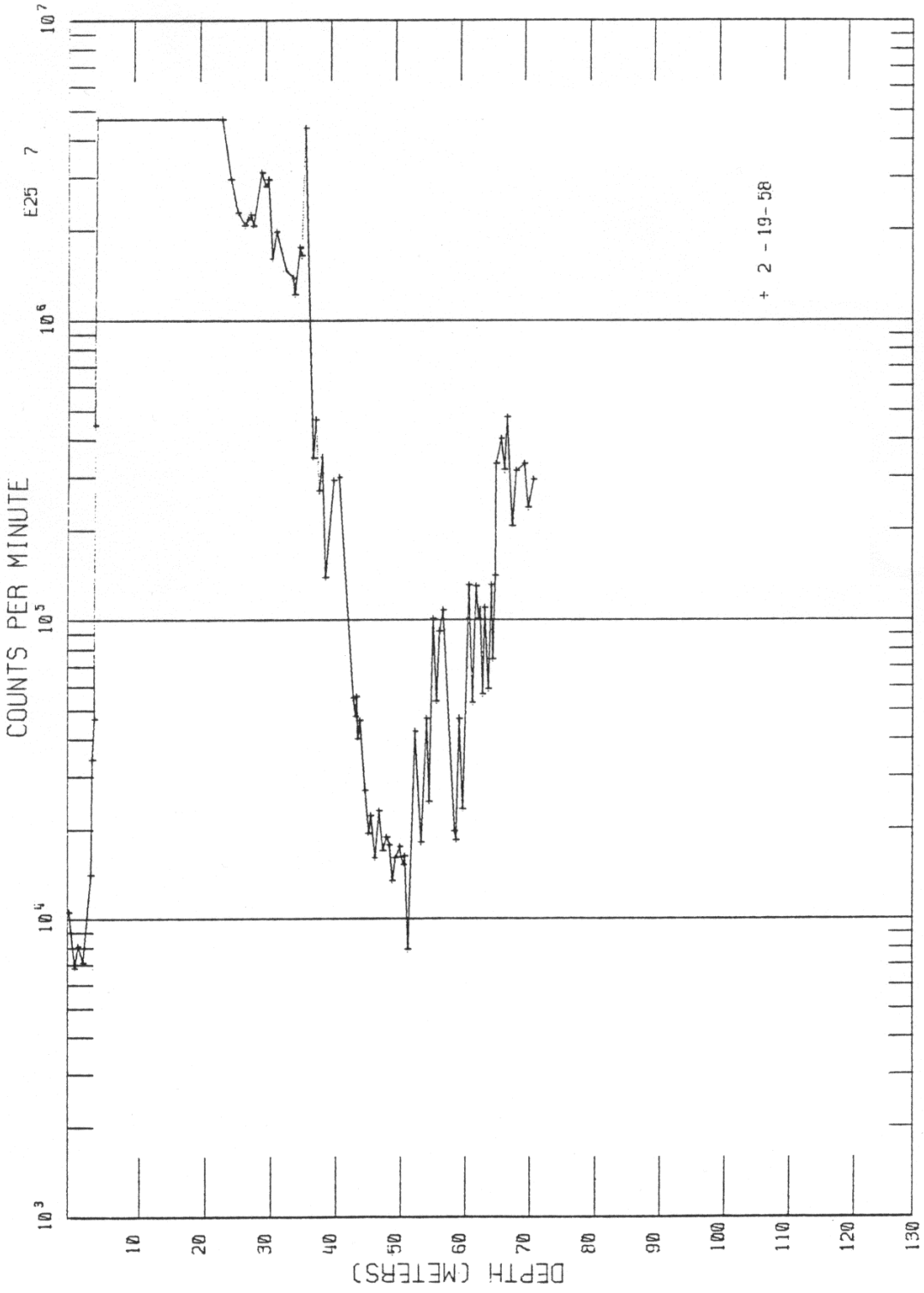
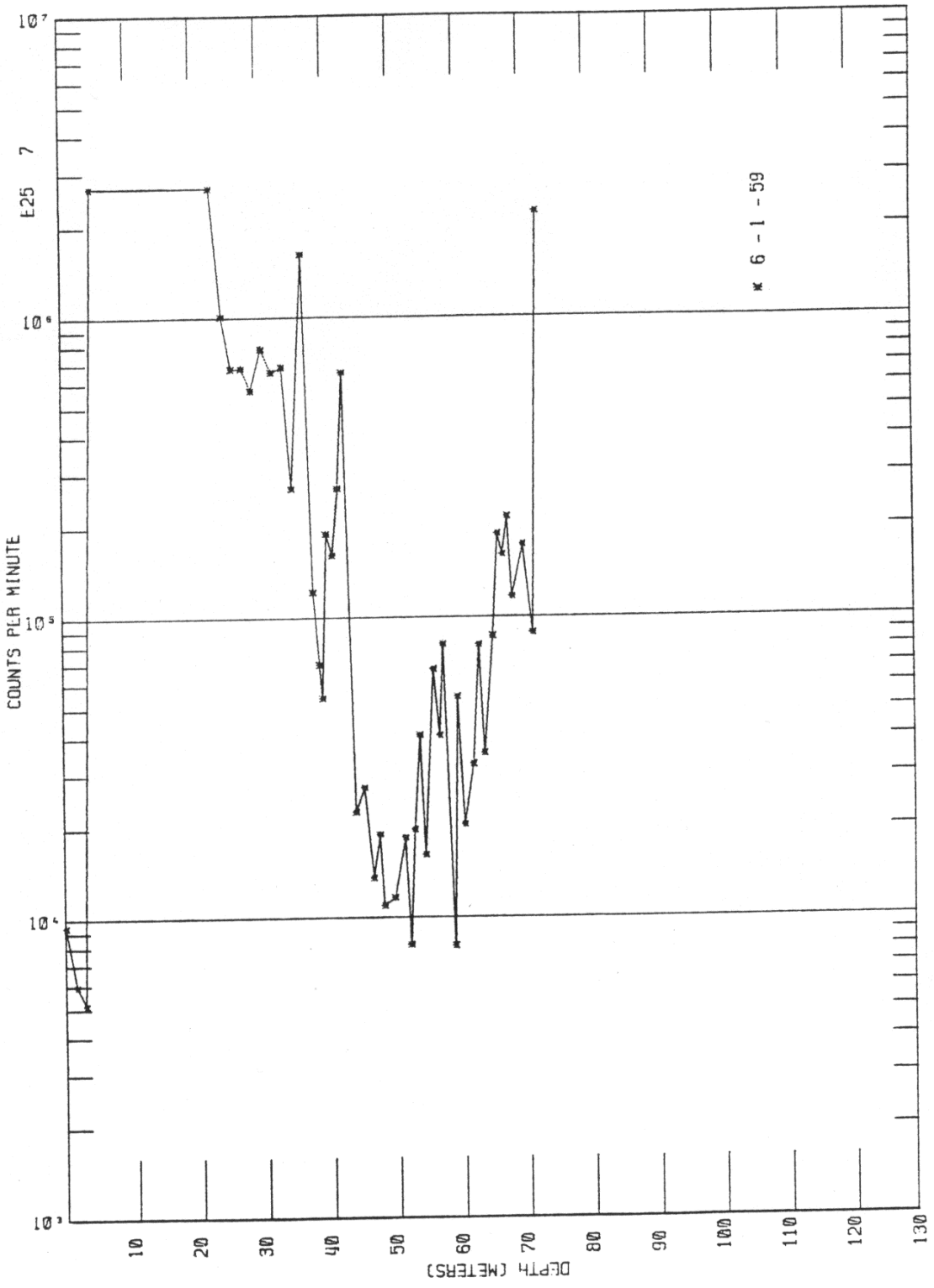
[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable



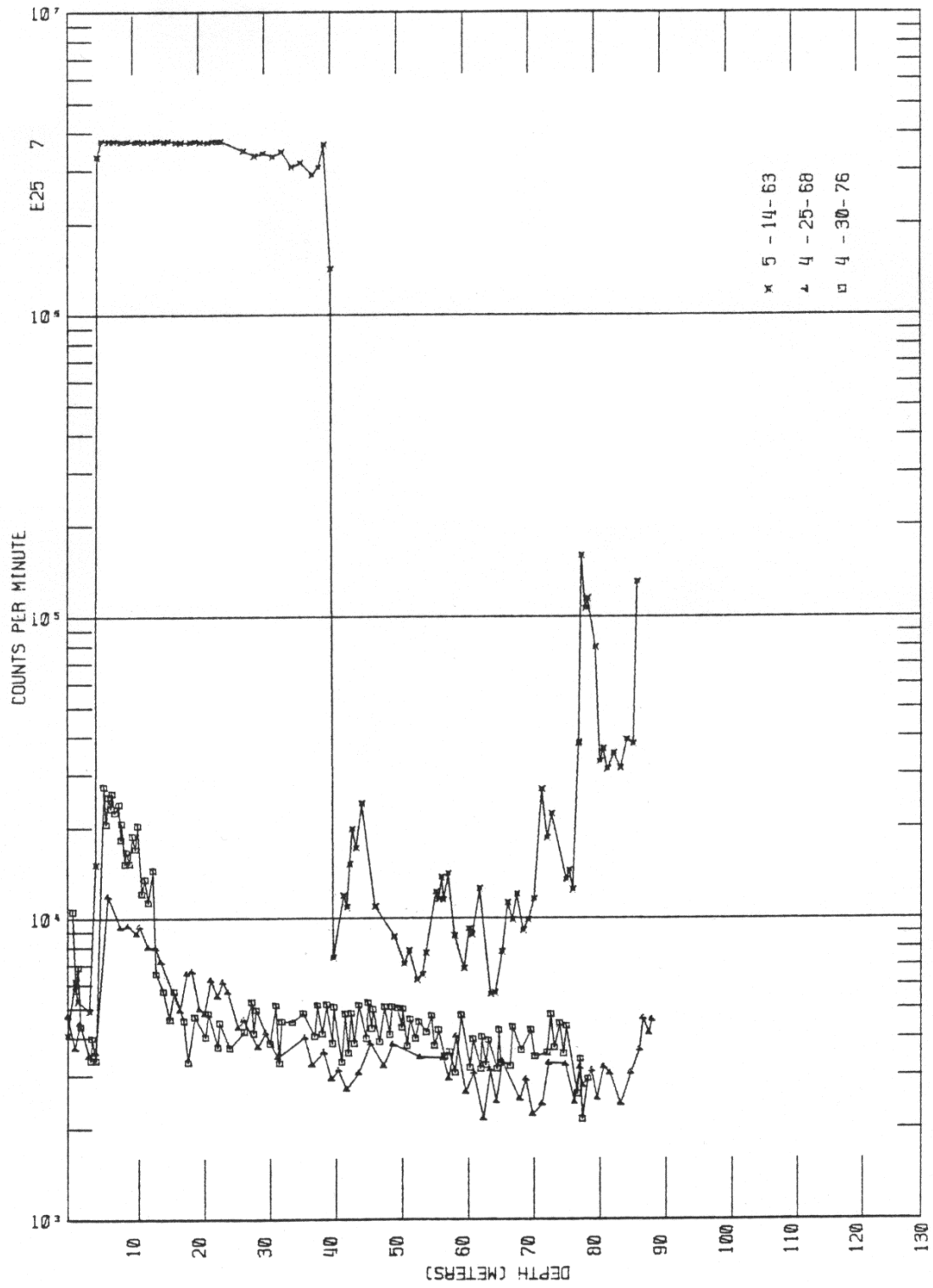
from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E25-7, Logged on 2/19/58



from Additon et al. (1978)

Scintillation Probe Profile for Borehole 299-E25-7, Logged on 6/1/59

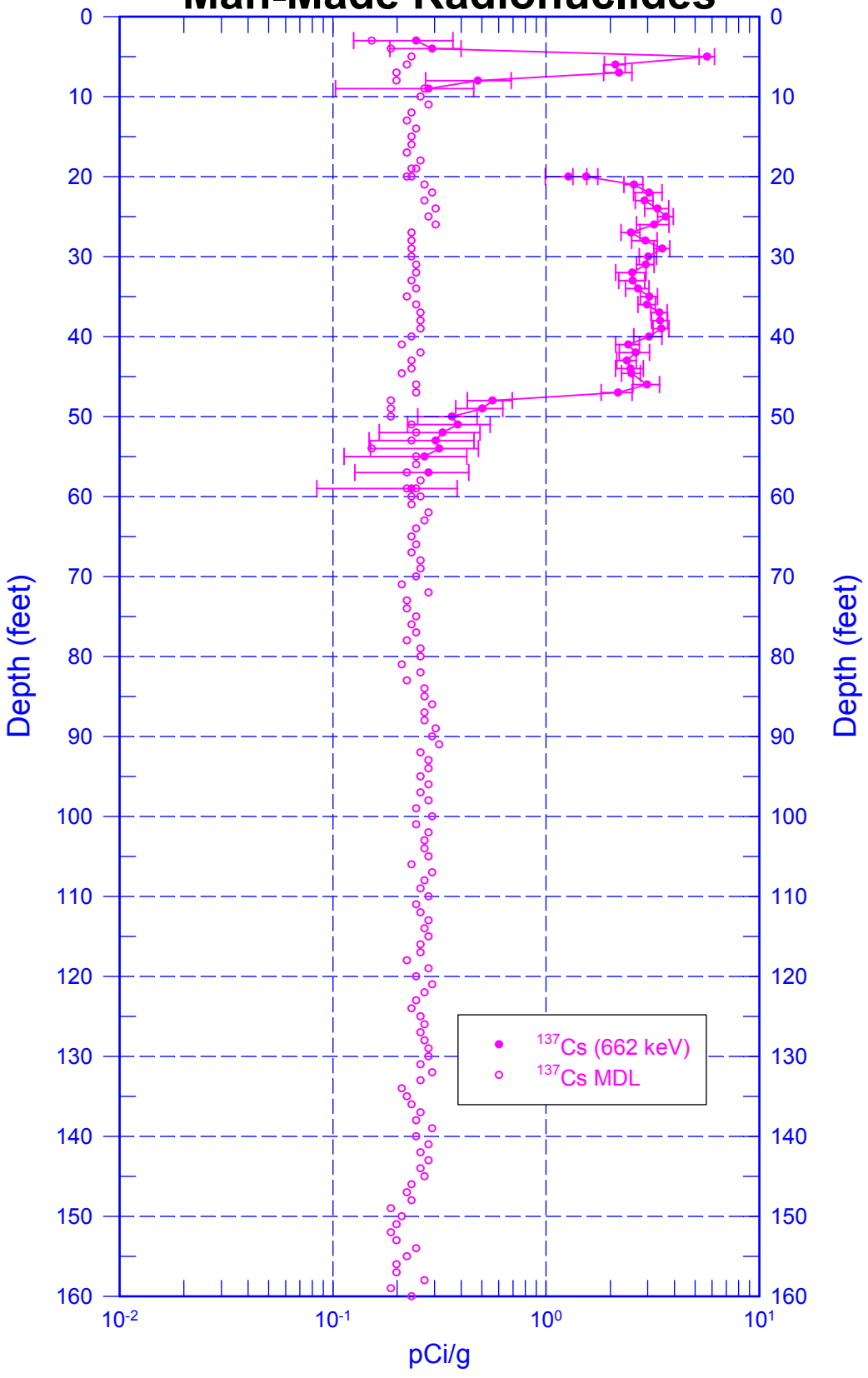


from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E25-7, Logged on 5/14/63, 4/25/68, and 4/30/76

299-E25-7 (A6026)

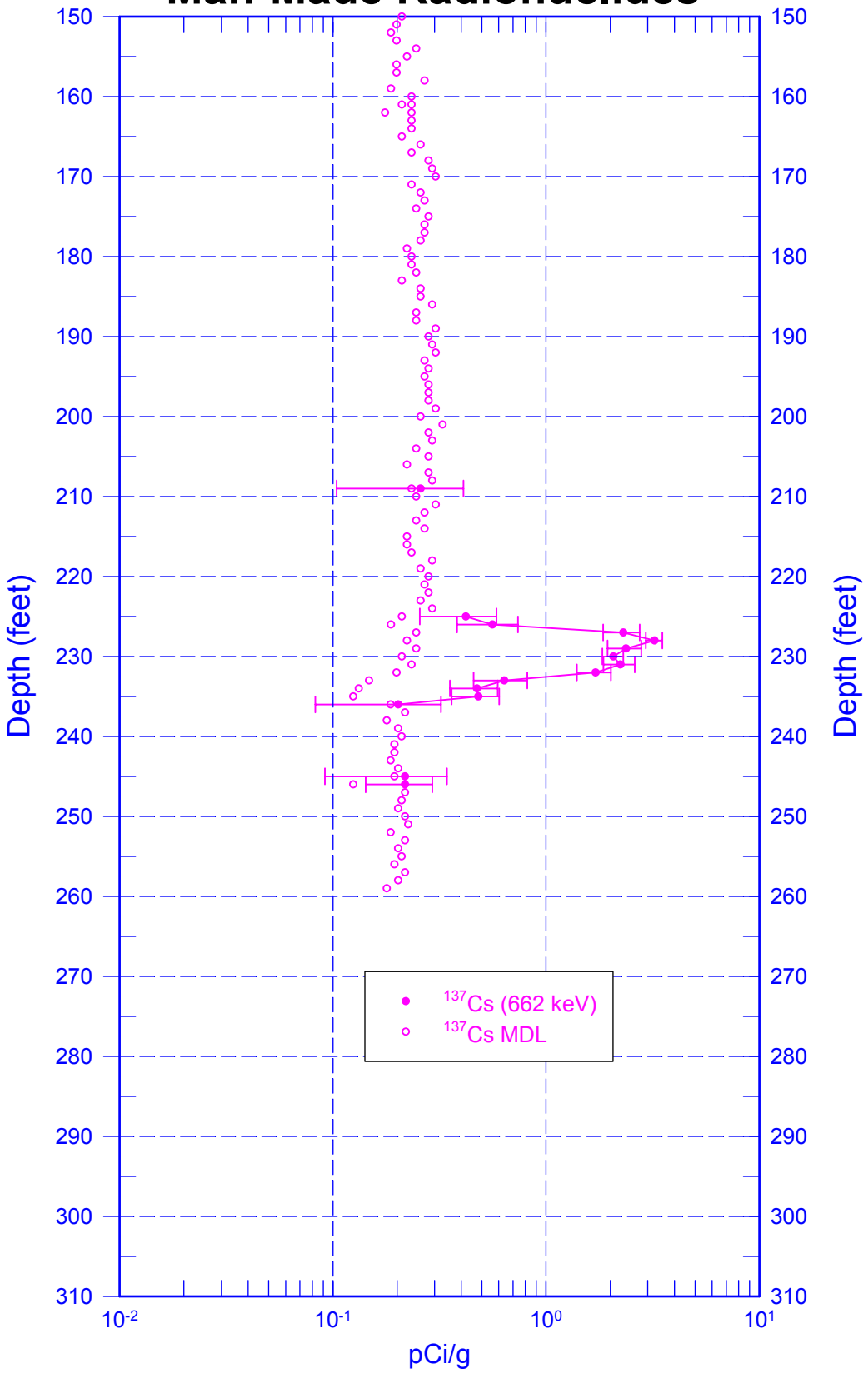
Man-Made Radionuclides



Zero Reference = Top of Casing

Date of Last Logging Run
4/21/2004

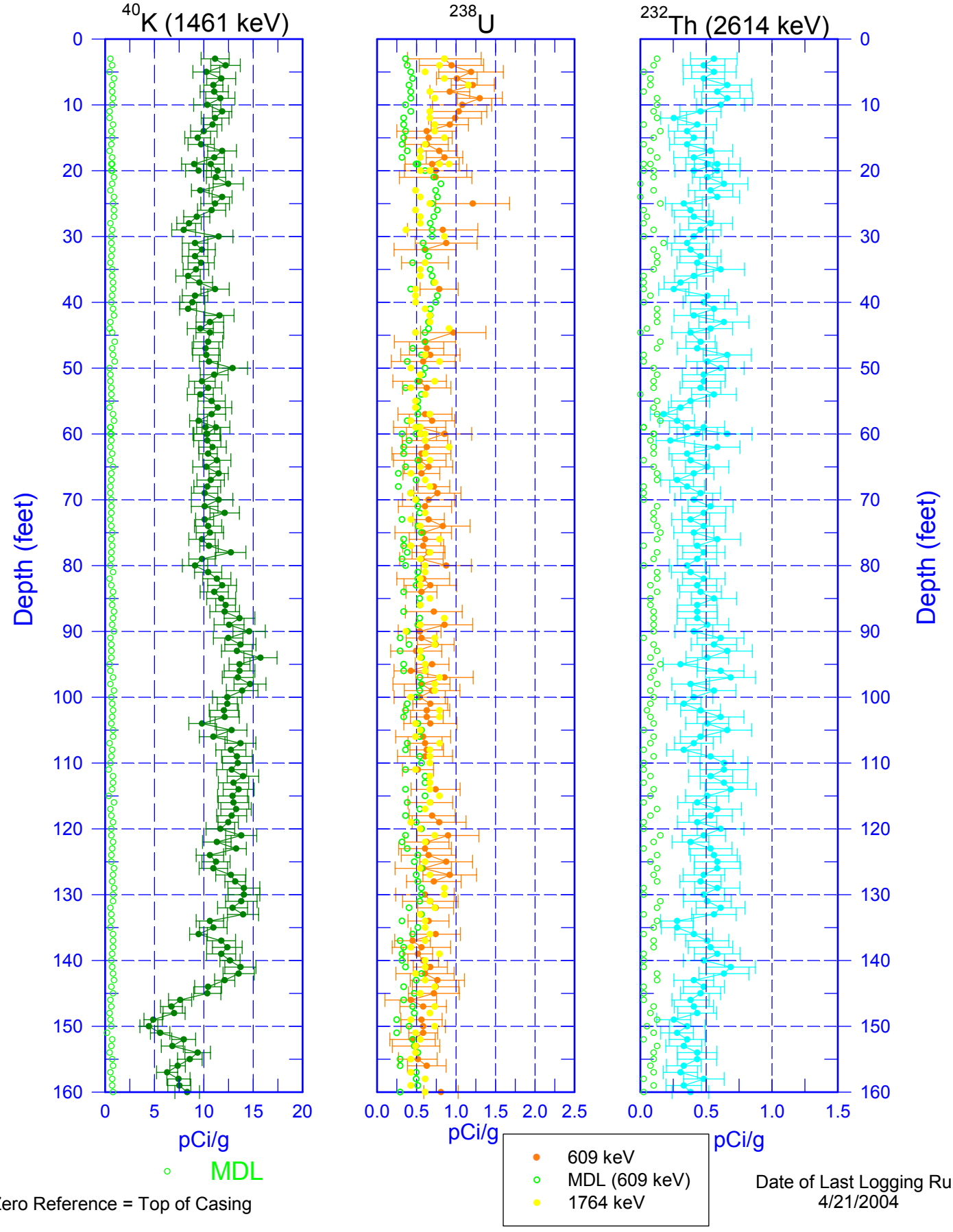
299-E25-7 (A6026)
Man-Made Radionuclides



Zero Reference = Top of Casing

Date of Last Logging Run
4/21/2004

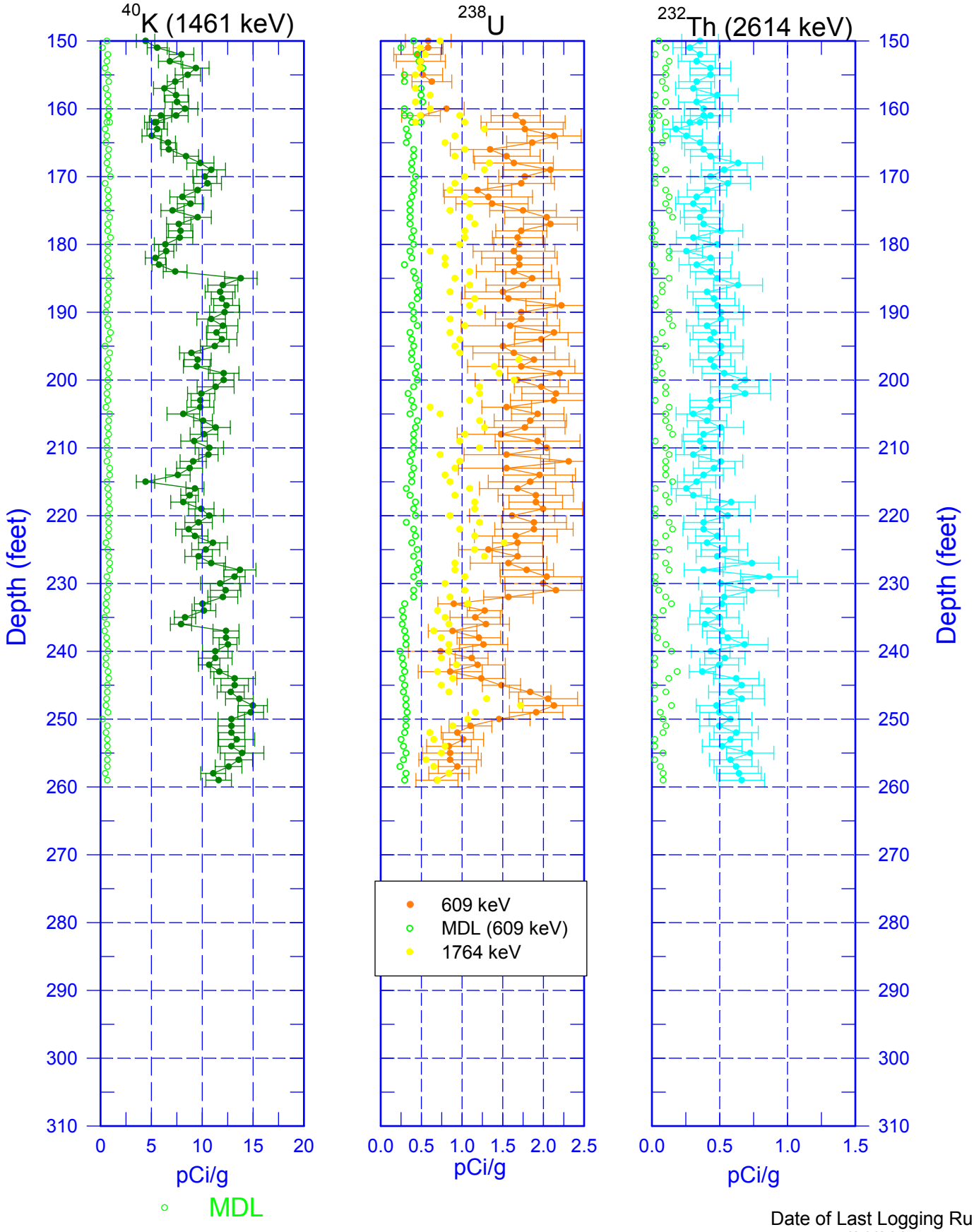
299-E25-7 (A6026)
Natural Gamma Logs



Zero Reference = Top of Casing

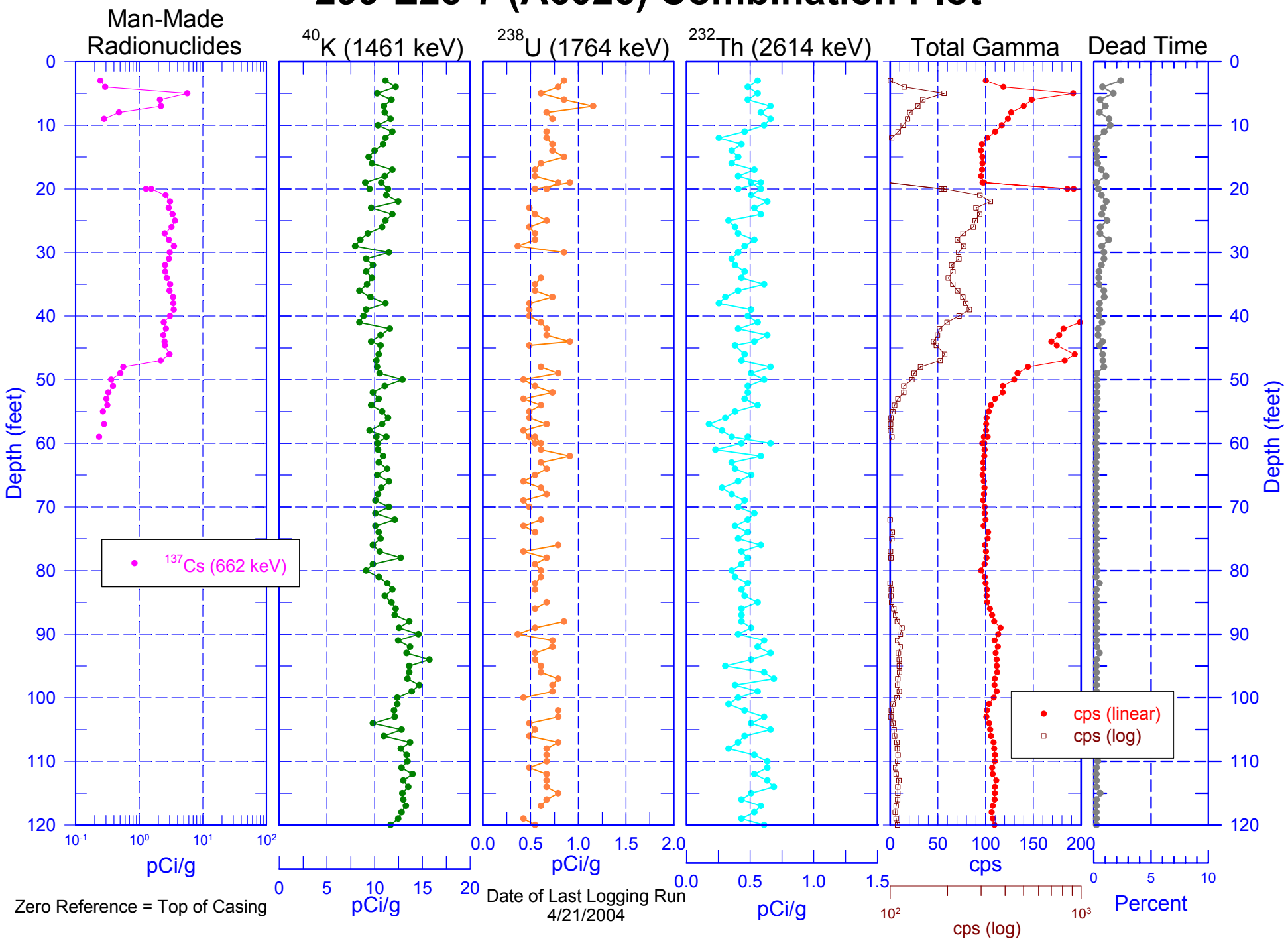
Date of Last Logging Run
4/21/2004

299-E25-7 (A6026)
Natural Gamma Logs

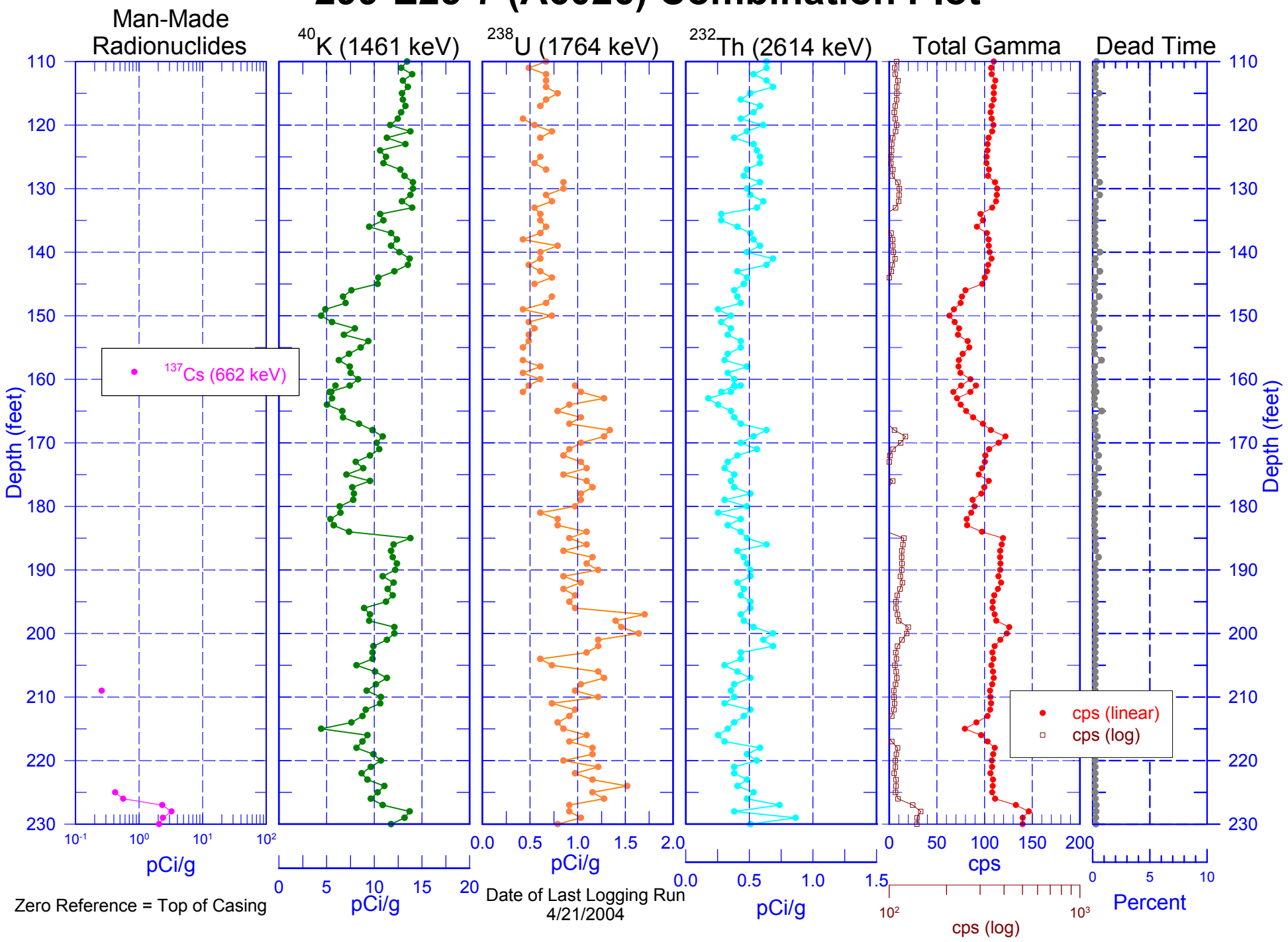


Zero Reference = Top of Casing

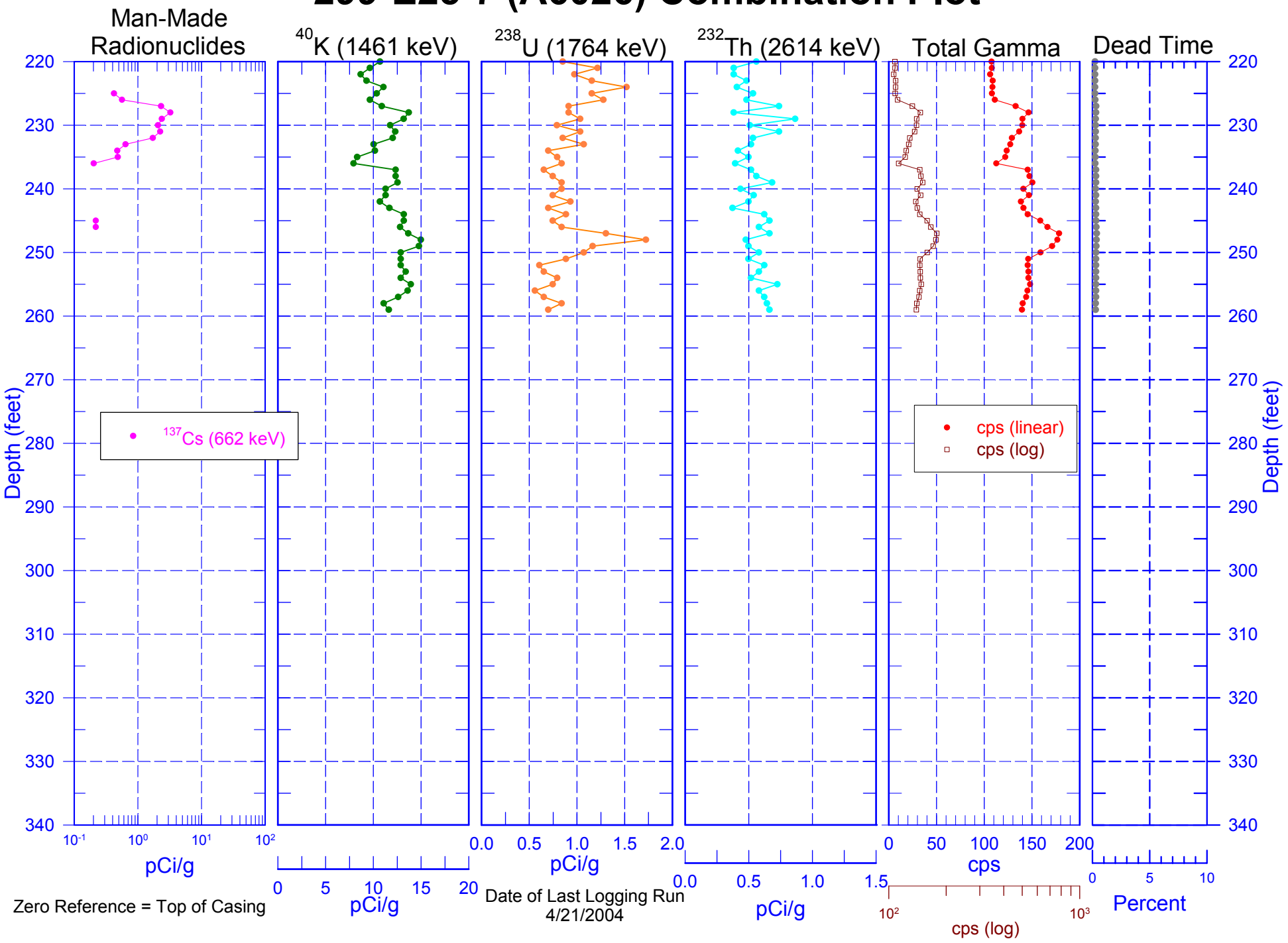
Date of Last Logging Run
4/21/2004


299-E25-7 (A6026) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Depth (feet)
137Cs (662 keV)
pCi/g
cps
cps (linear)
cps (log)
Percent
Zero Reference = Top of Casing
Date of Last Logging Run
4/21/2004

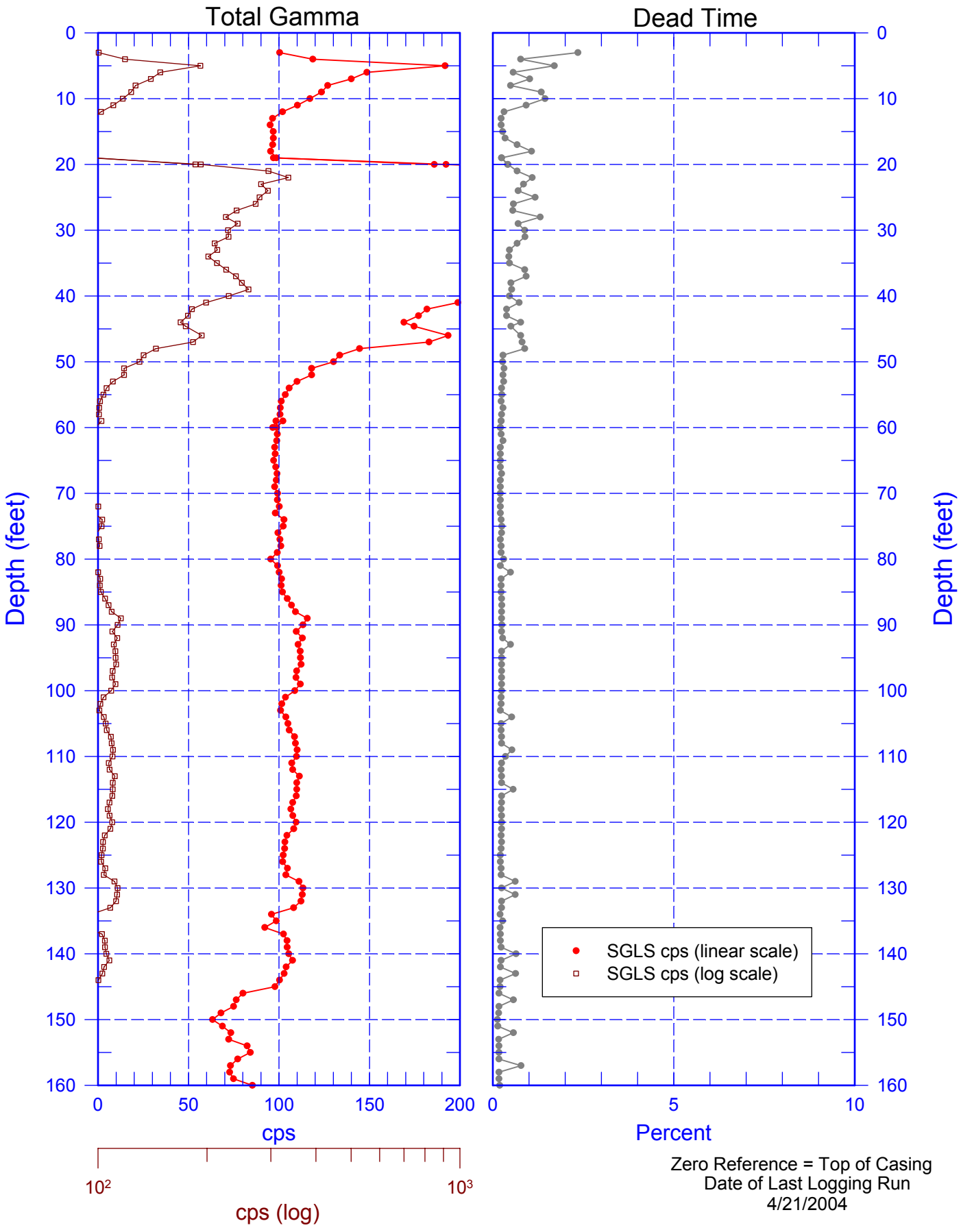
299-E25-7 (A6026) Combination Plot



299-E25-7 (A6026) Combination Plot

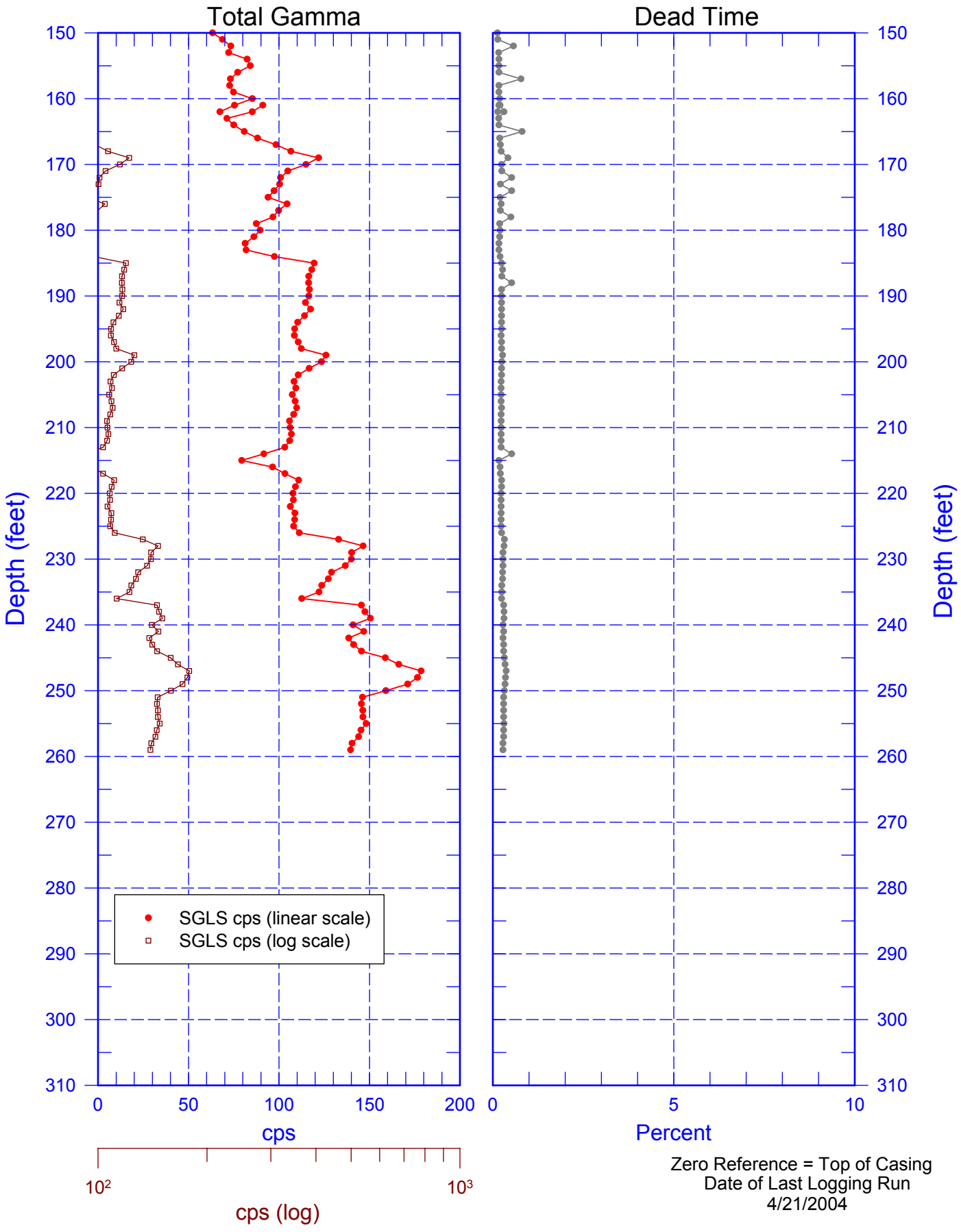


299-E25-7 (A6026)
Total Gamma & Dead Time



Zero Reference = Top of Casing
Date of Last Logging Run
4/21/2004

299-E25-7 (A6026)
Total Gamma & Dead Time

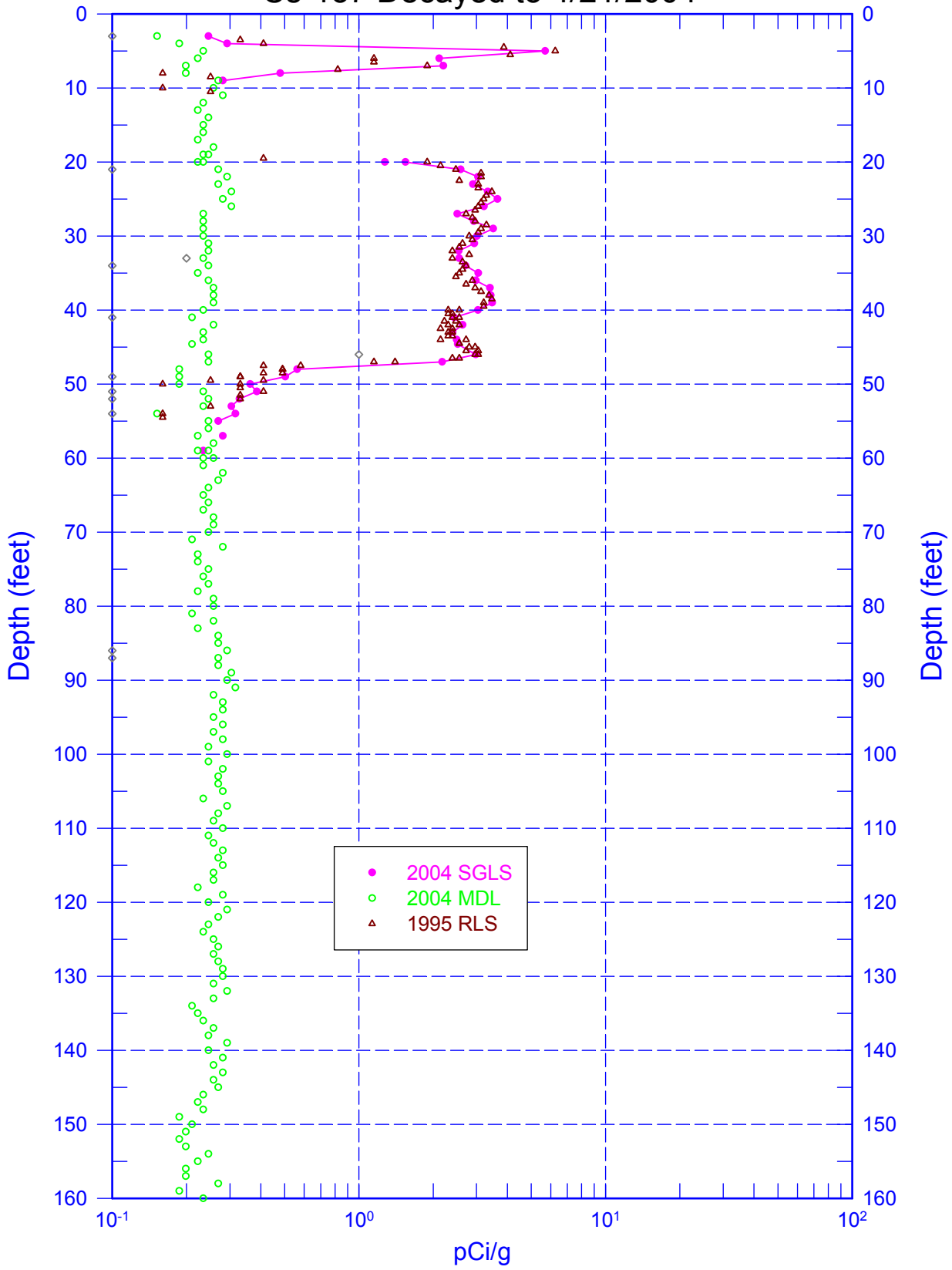


Zero Reference = Top of Casing
Date of Last Logging Run
4/21/2004

299-E25-7 (A6026)

RLS Data Compared to SGLS Data

Cs-137 Decayed to 4/21/2004

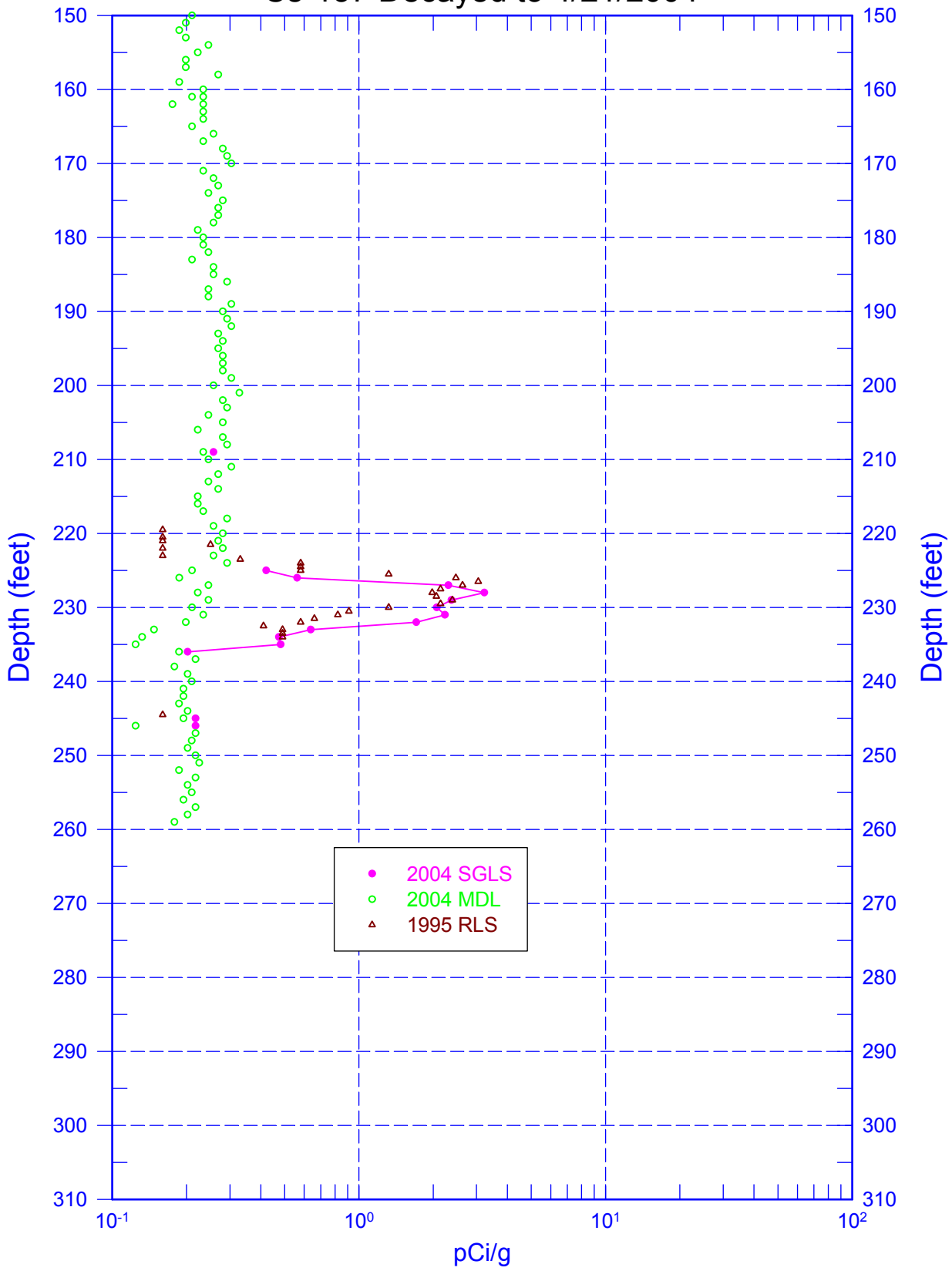


Zero Reference = Top of Casing (2004 SGLS)

299-E25-7 (A6026)

RLS Data Compared to SGLS Data

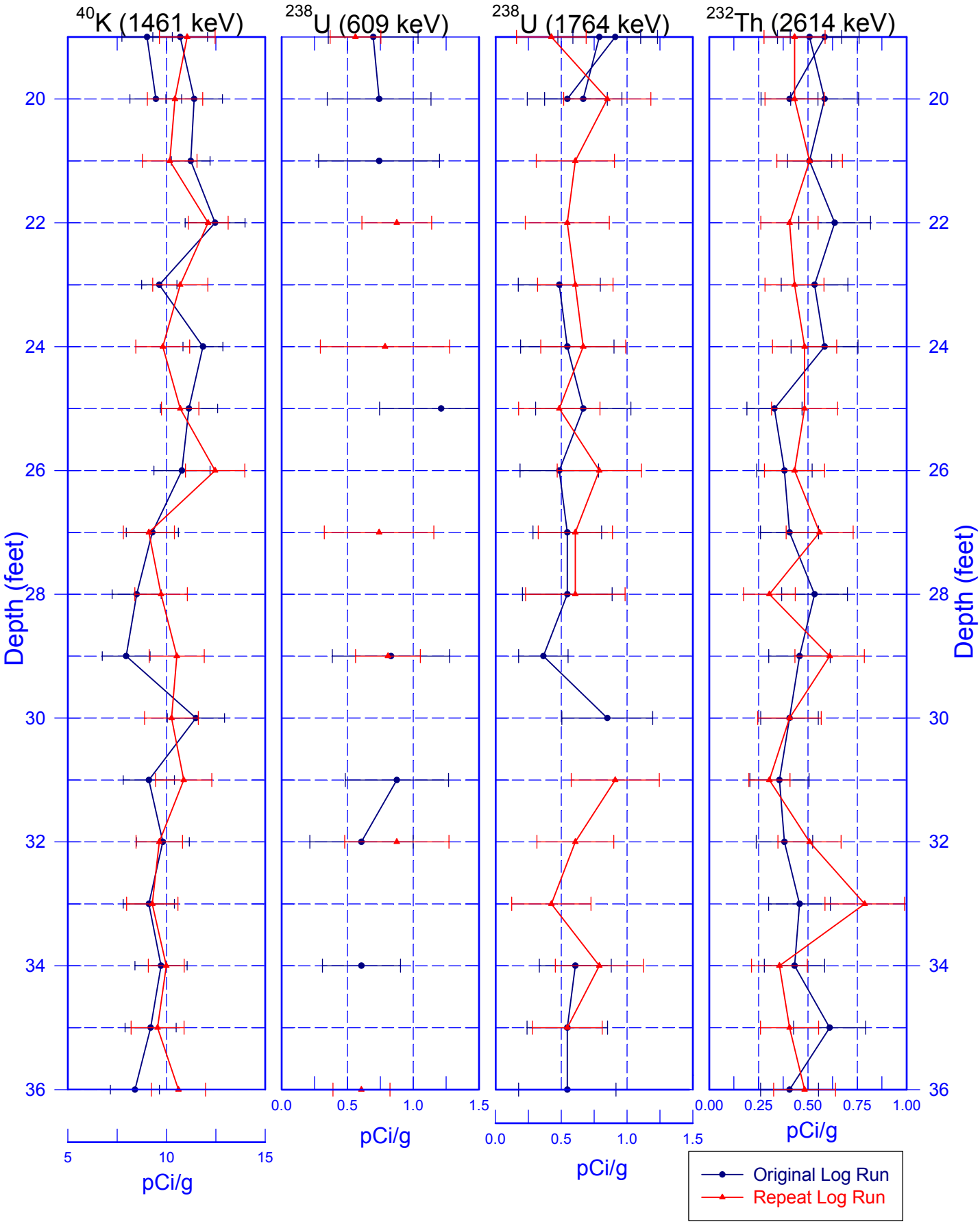
Cs-137 Decayed to 4/21/2004



Zero Reference = Top of Casing (2004 SGLS)

299-E25-7 (A6026)

Rerun of Natural Gamma Logs (36.0 to 19.0 ft)



299-E25-7 (A6026)

Man-Made Radionuclides